

Figure 1

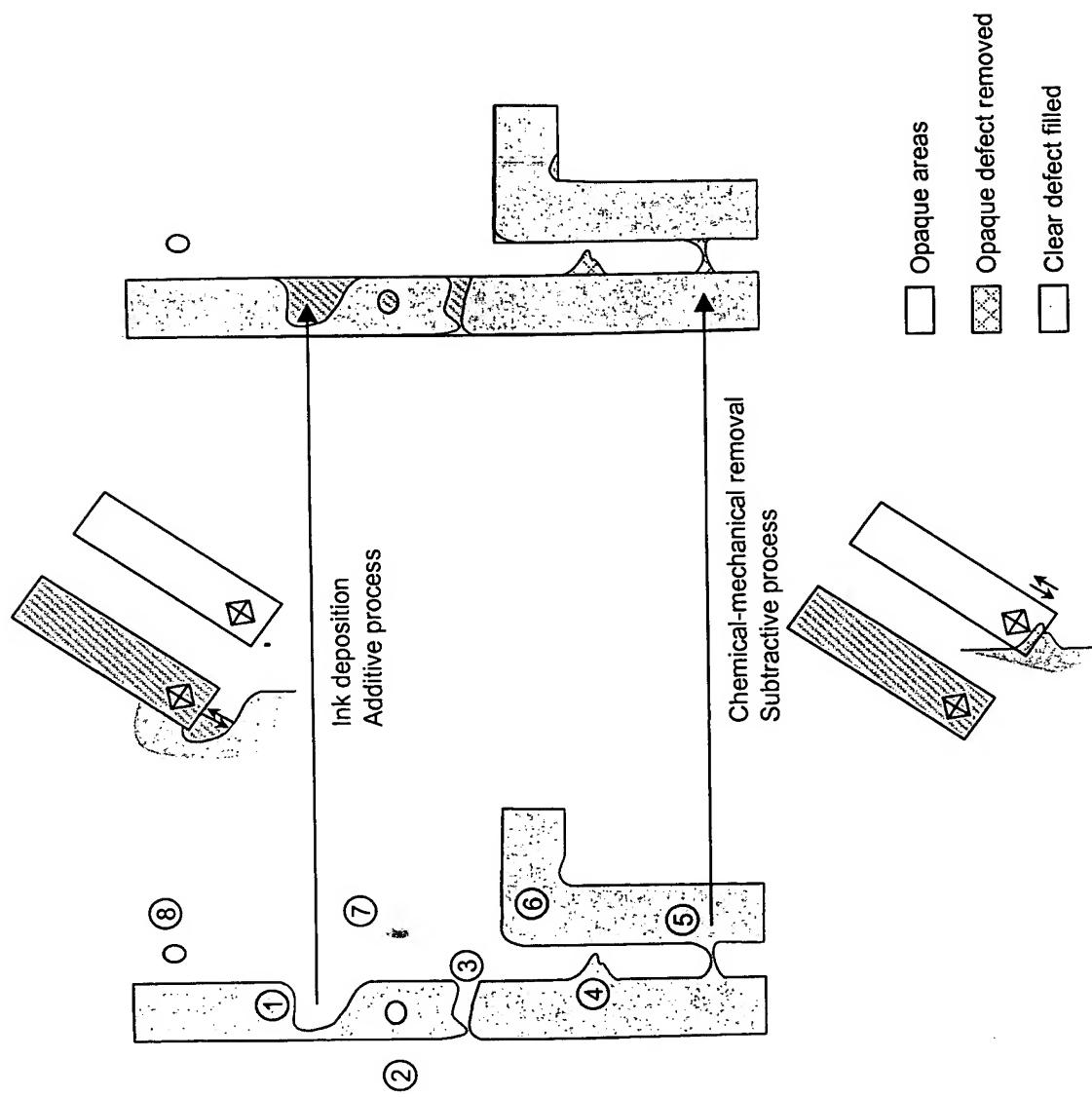


Figure 2

Location of the initial defect (top detailed view) on the photomask wafer

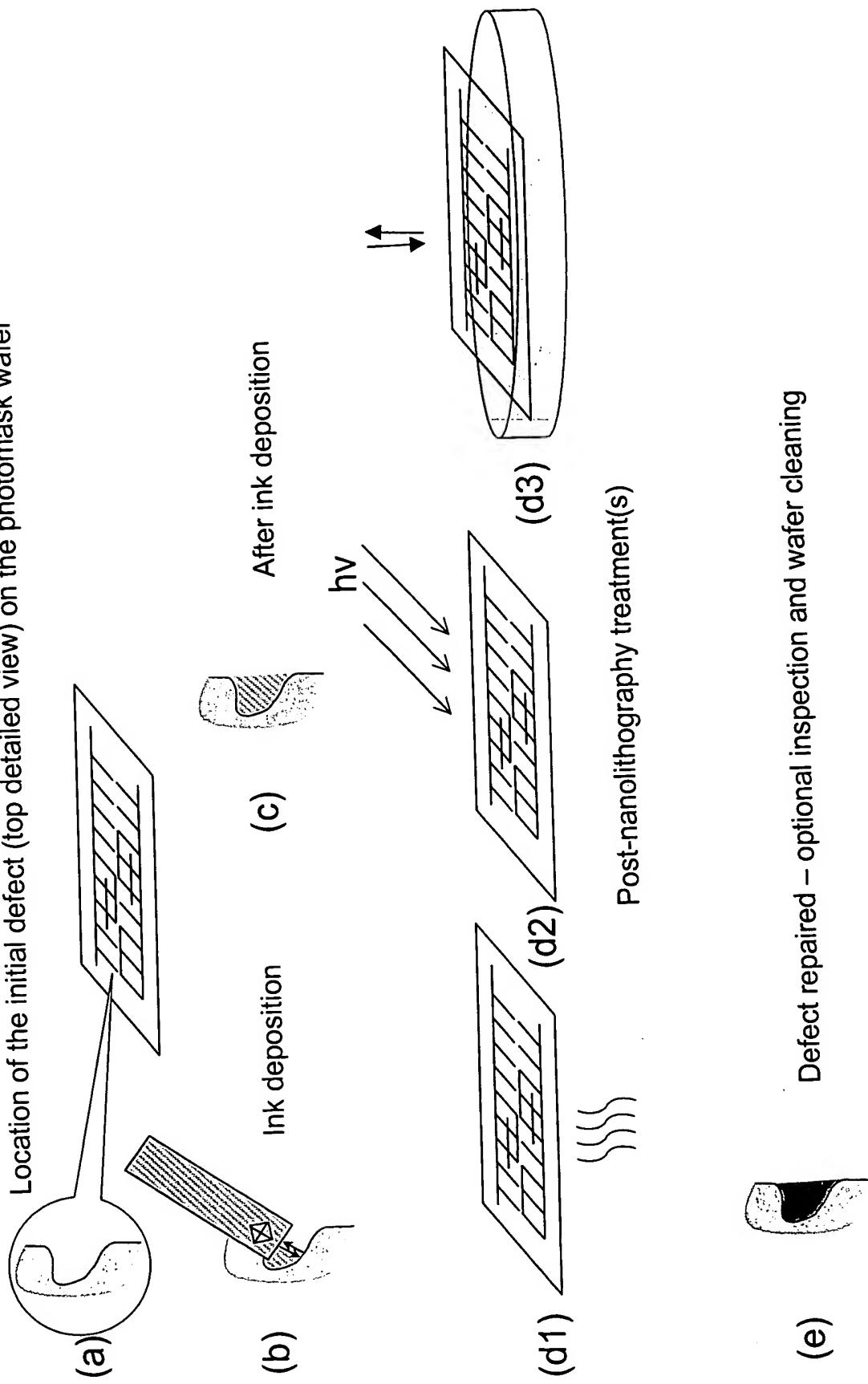


Figure 3A

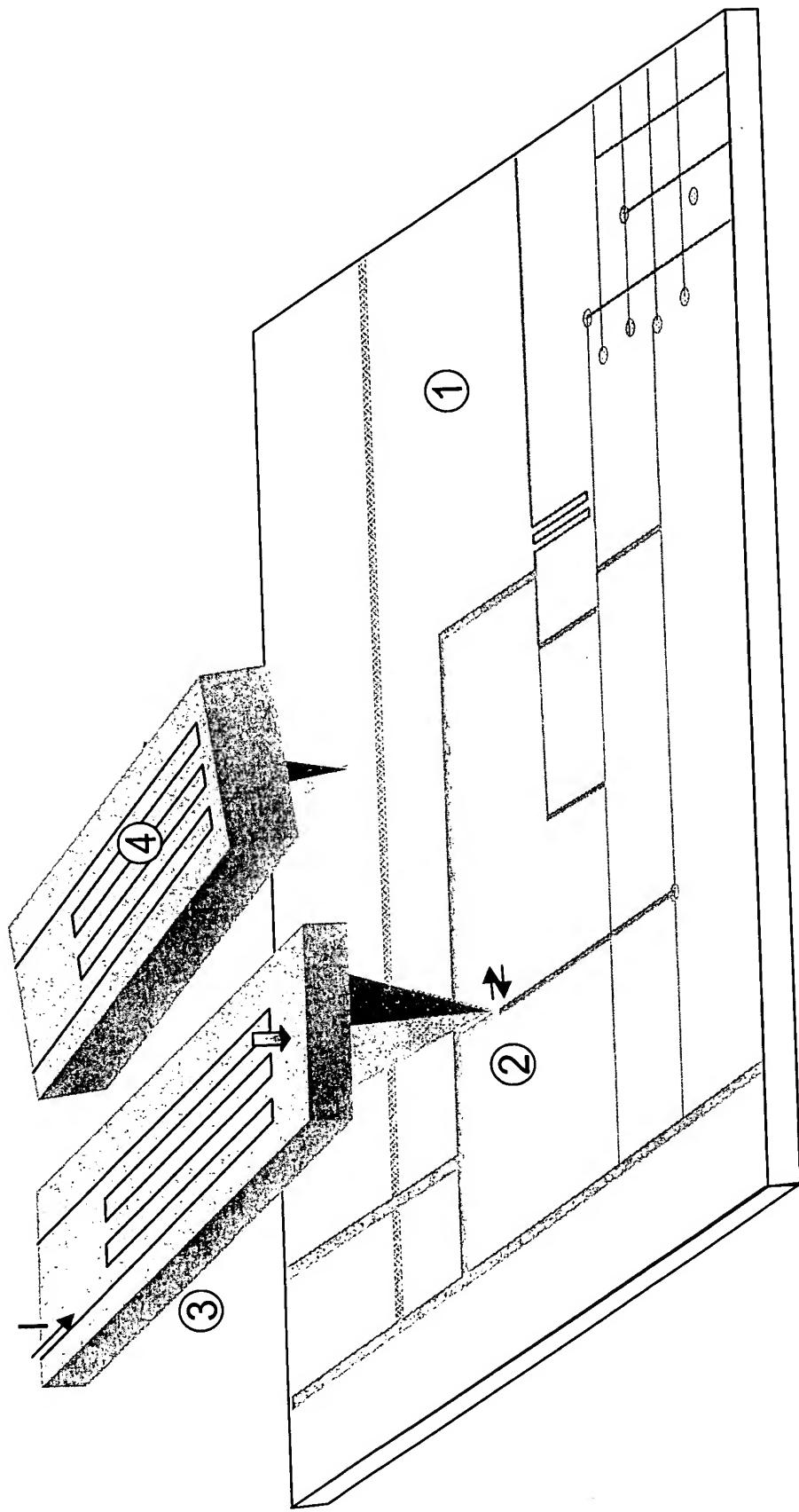


Figure 3B

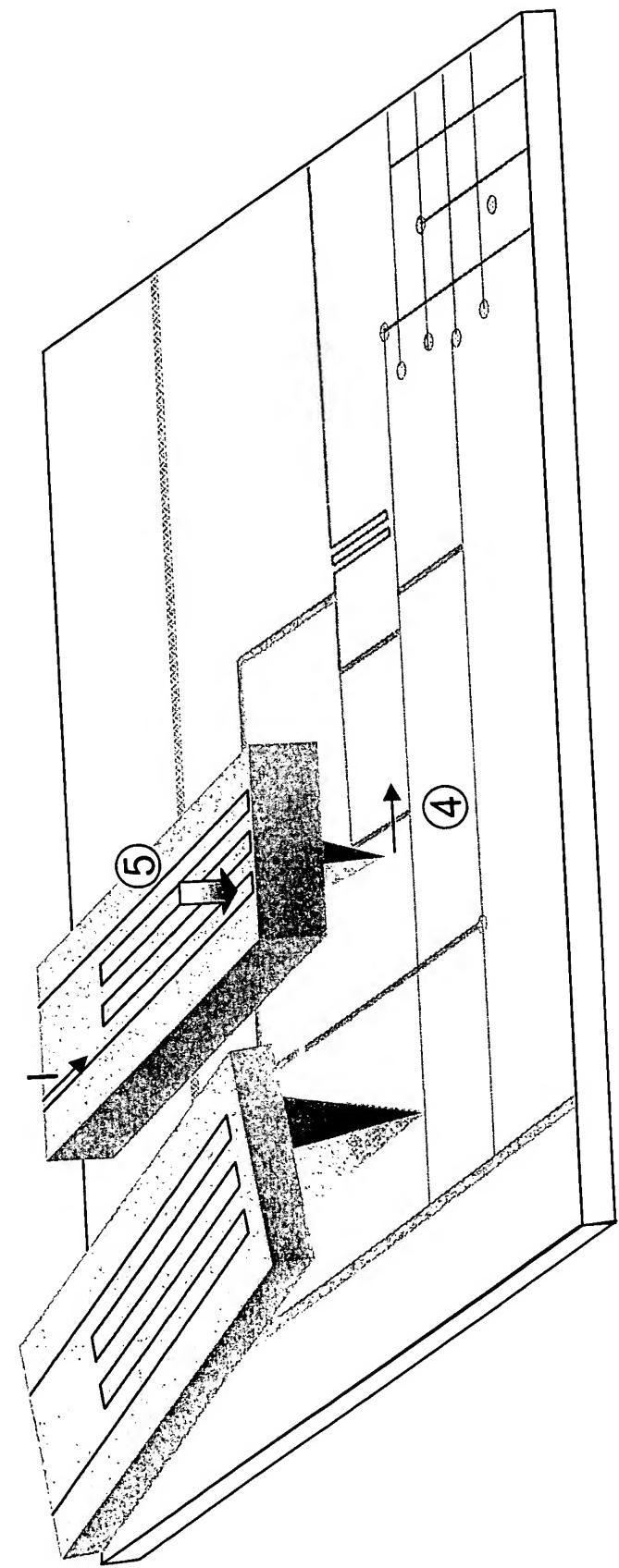
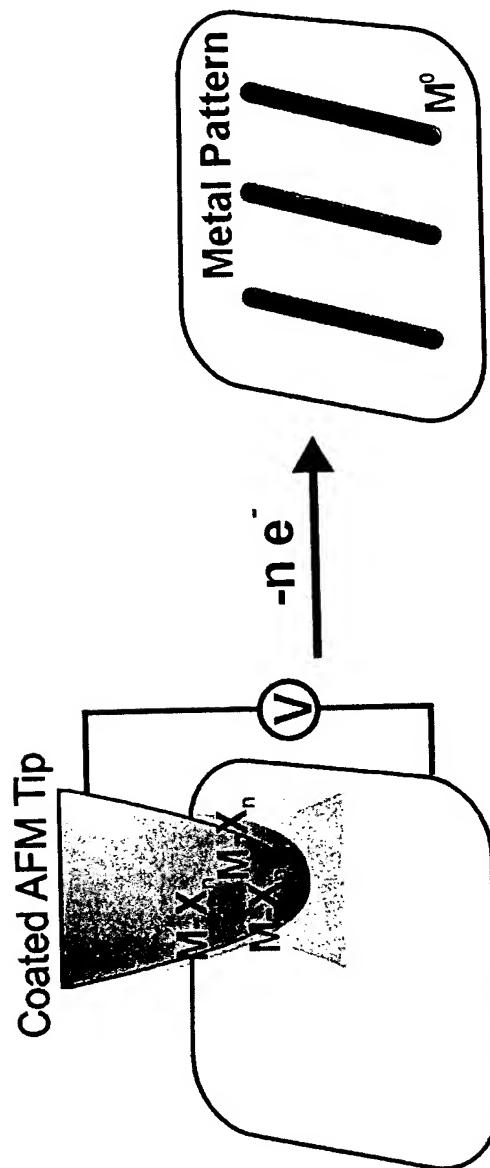


Figure 4



Title: Nanometer-Scale Engineered Structures, Methods
and Apparatus for Fabrication thereof, and Applications
to Photomask Repair and Enhancement
Inventor(s): Percy Van Crocker et al.
Attorney Docket No.: 083847-0198

Figure 5

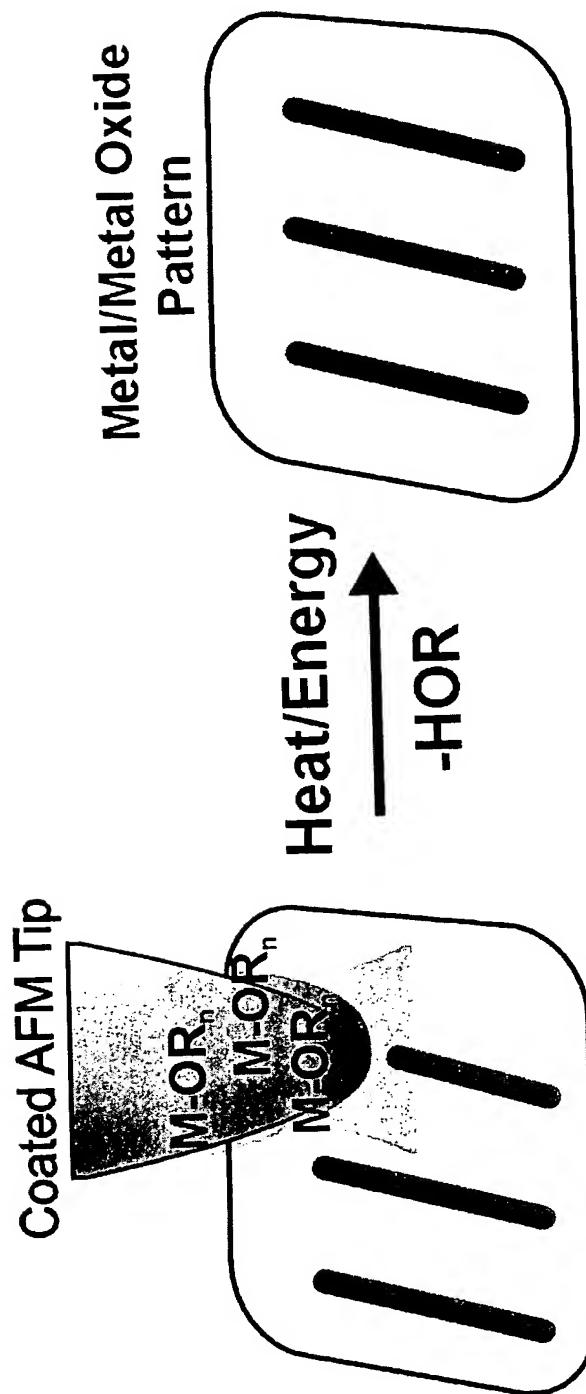
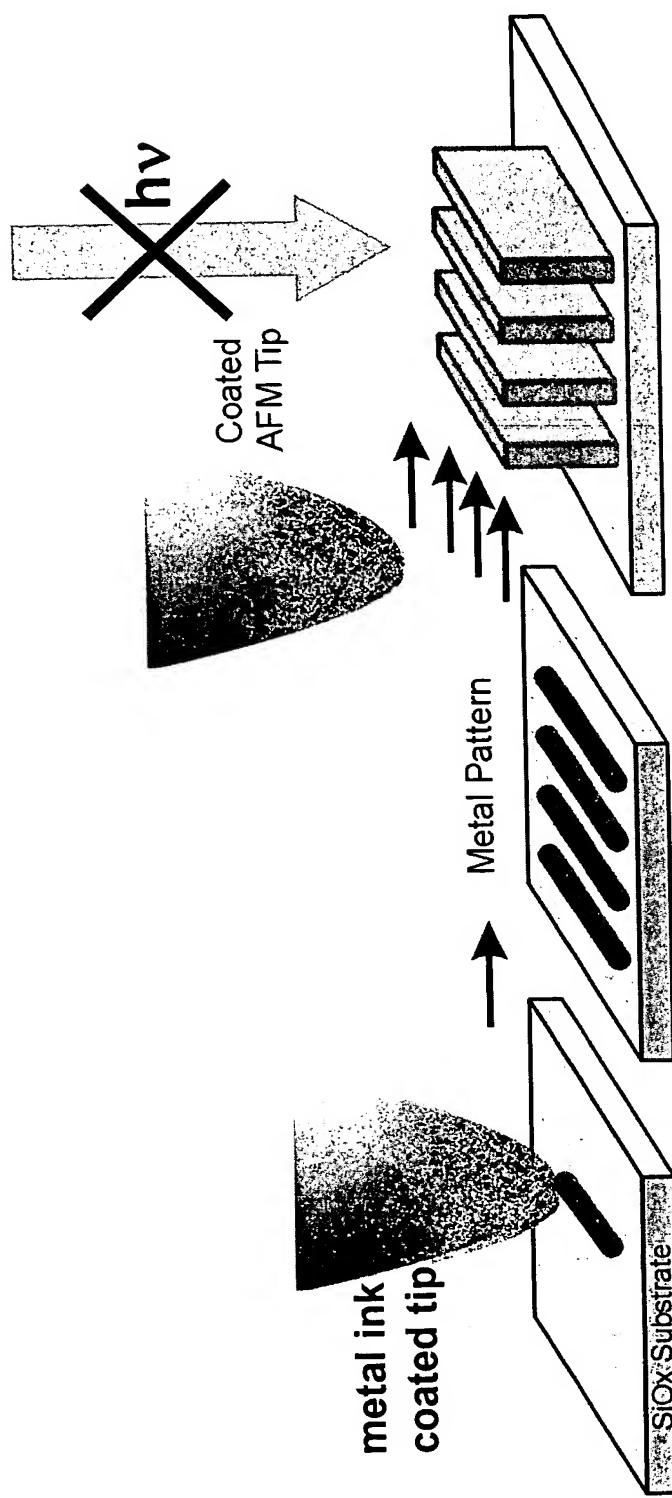


Figure 6



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Figure 7

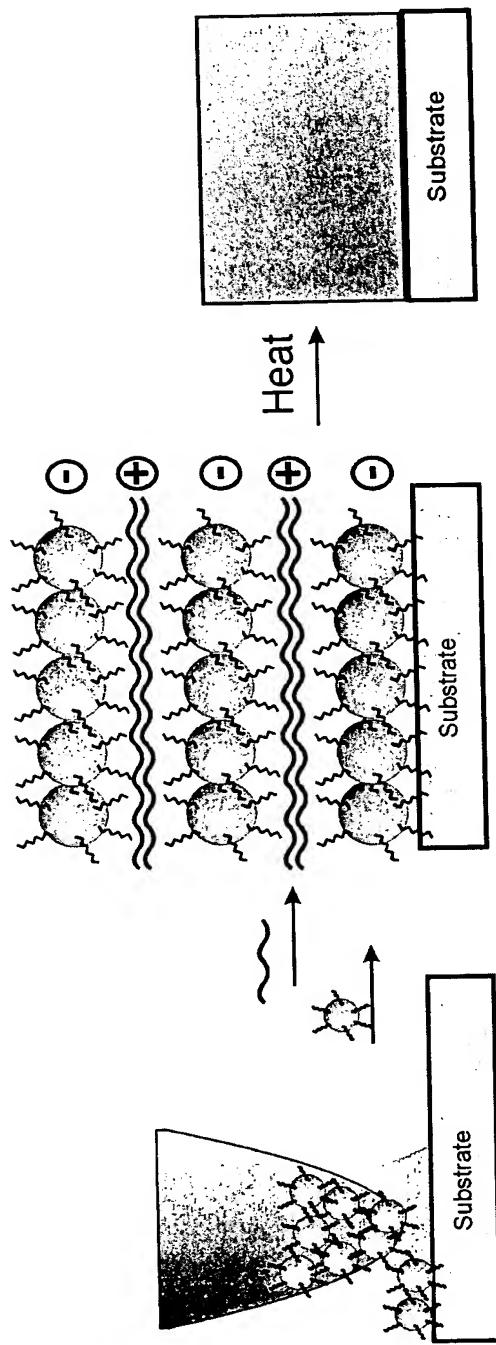


Figure 8

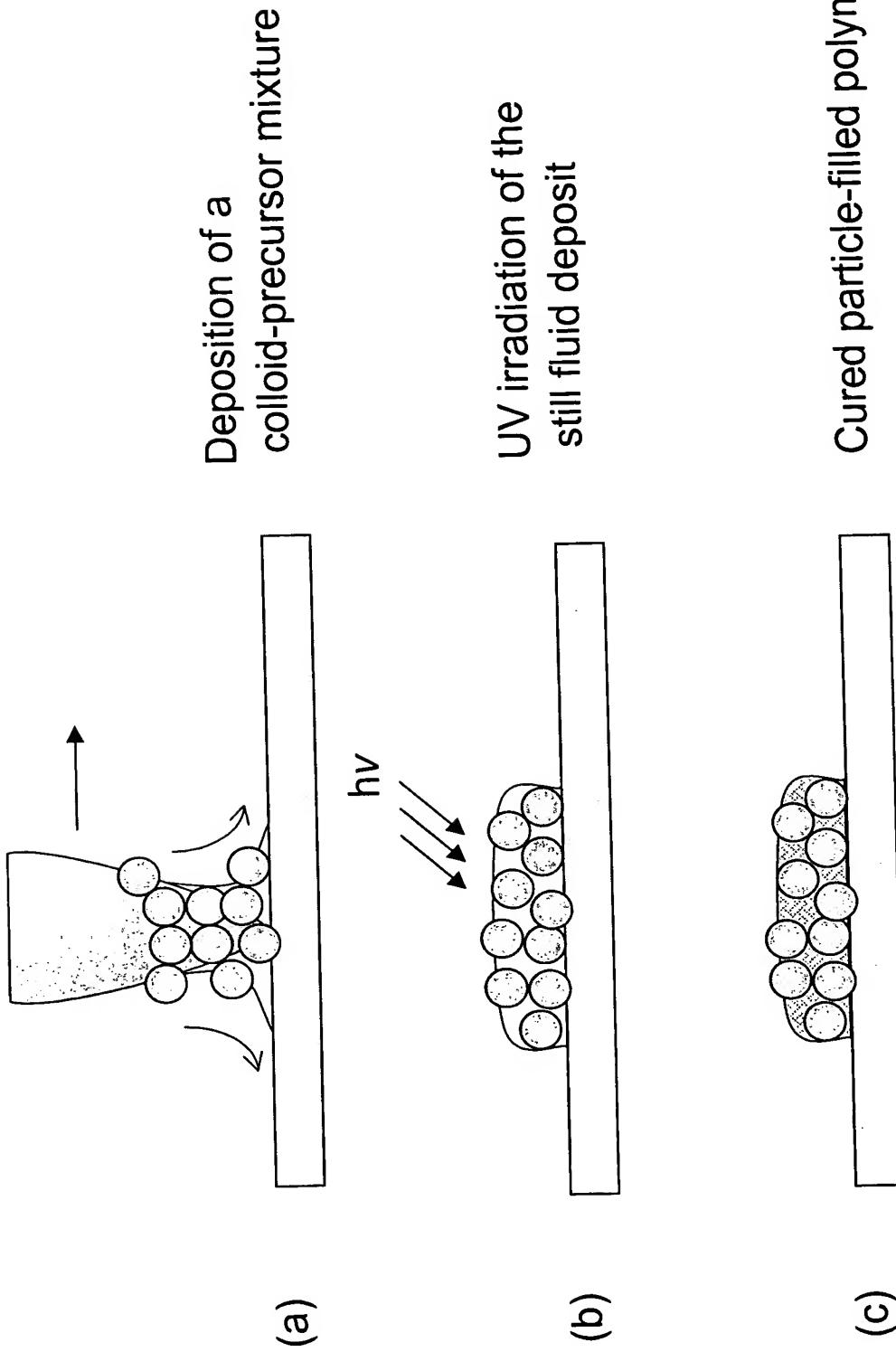


Figure 9

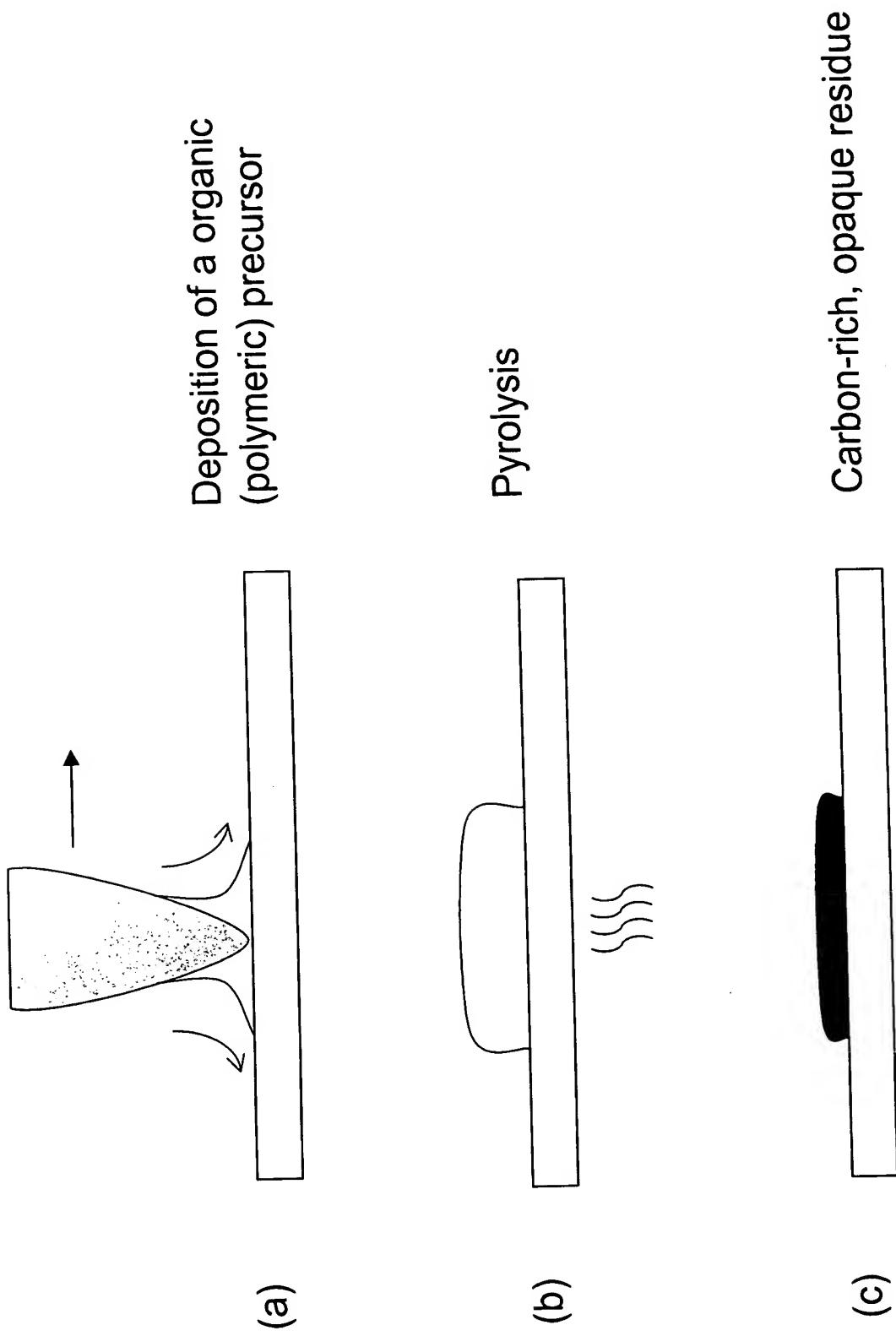
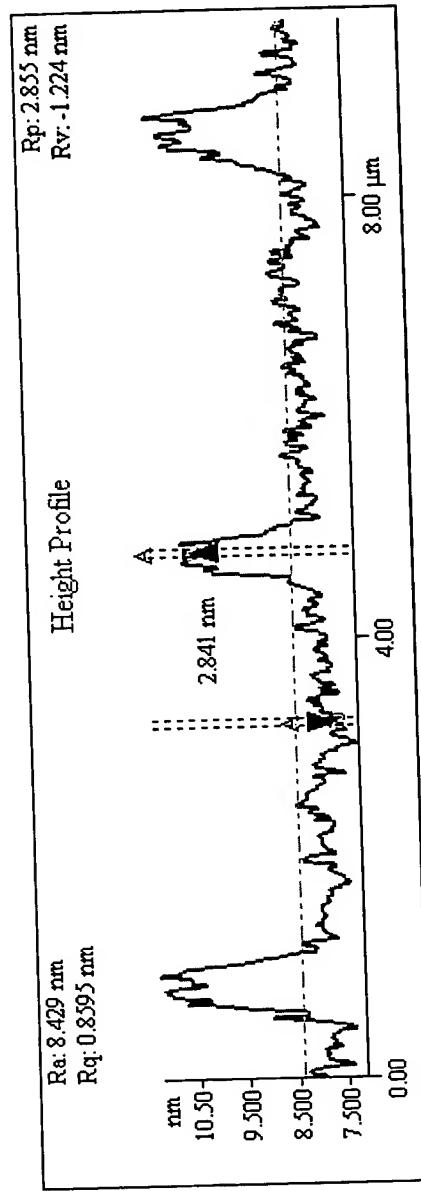
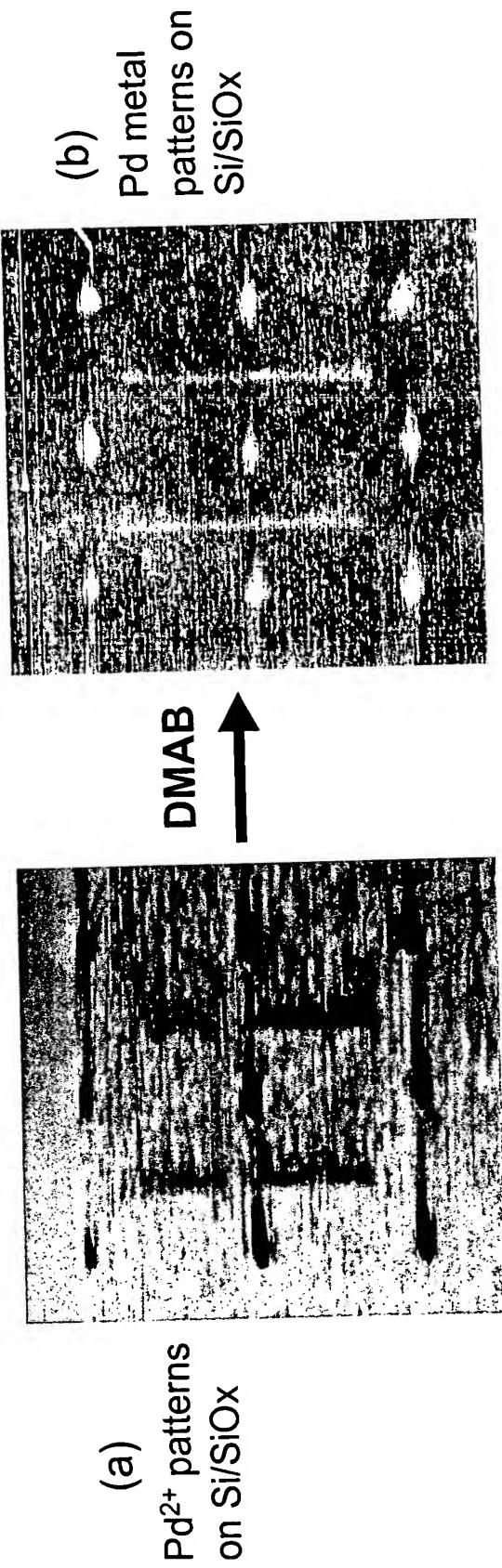


Figure 10

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(c)
Line scan indicating
height of metal dots

Figure 11

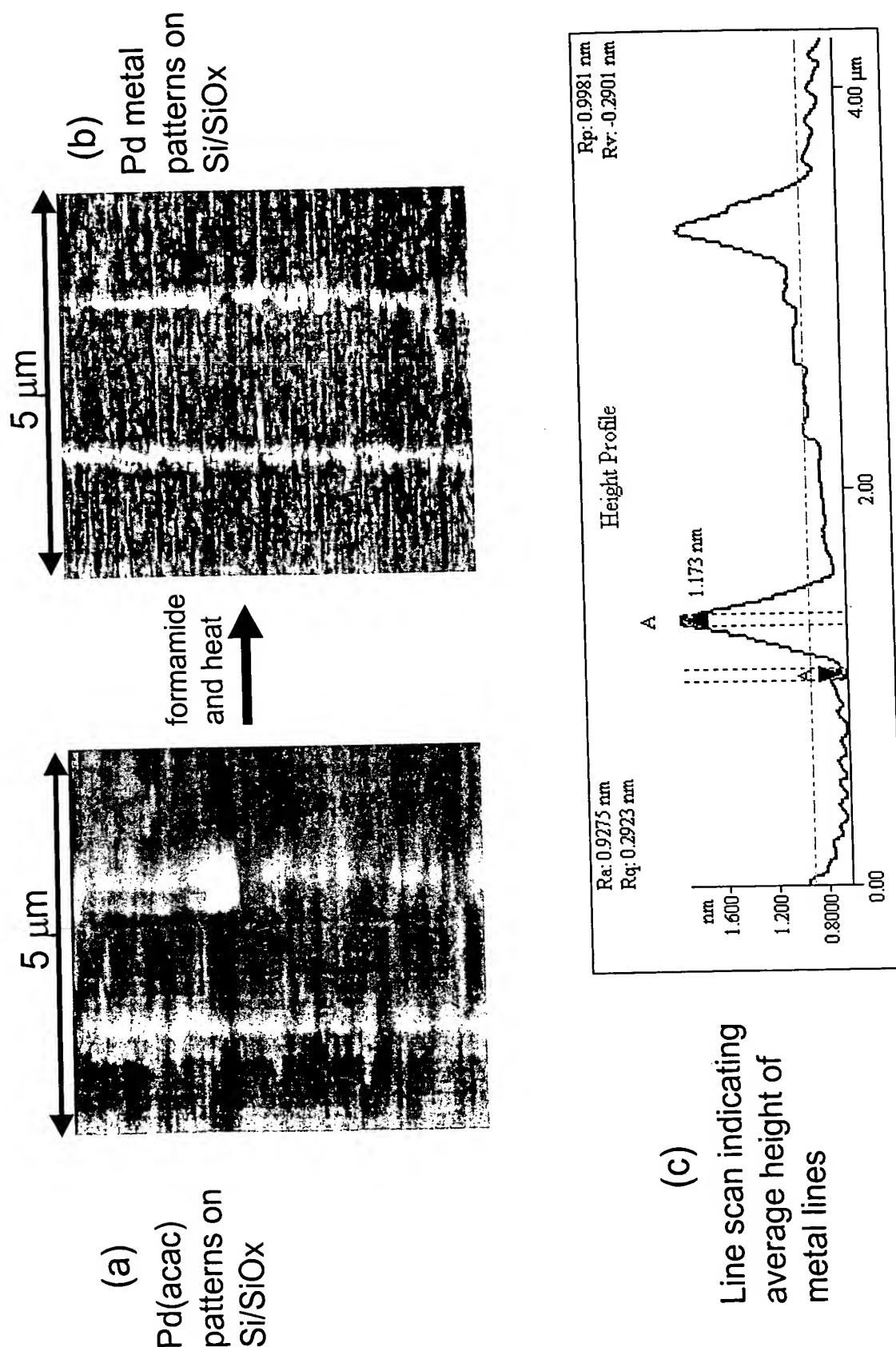
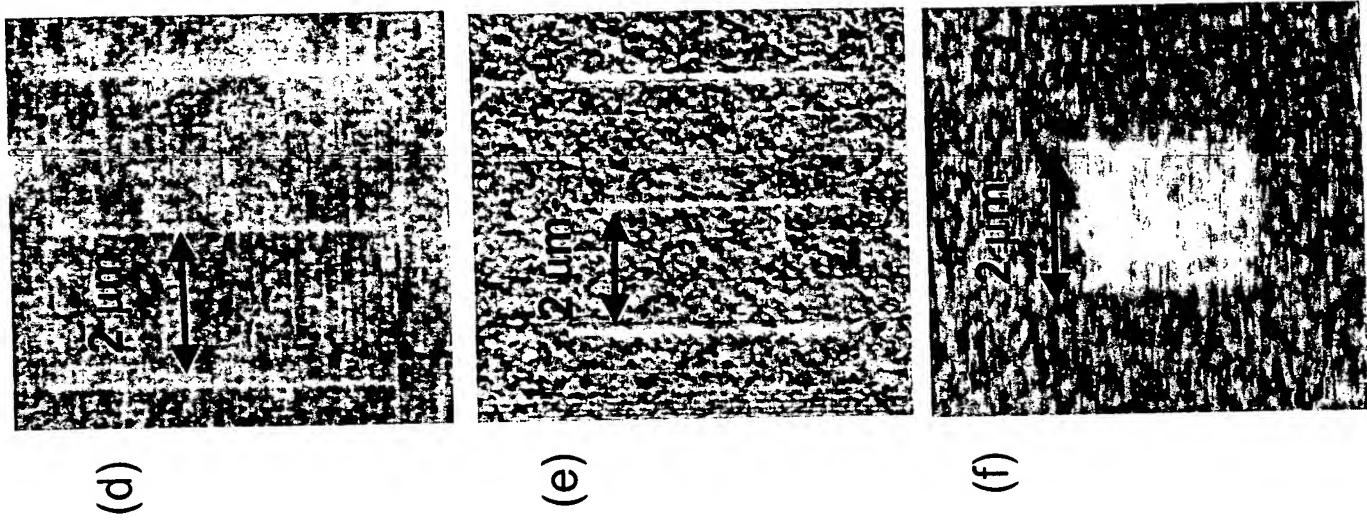


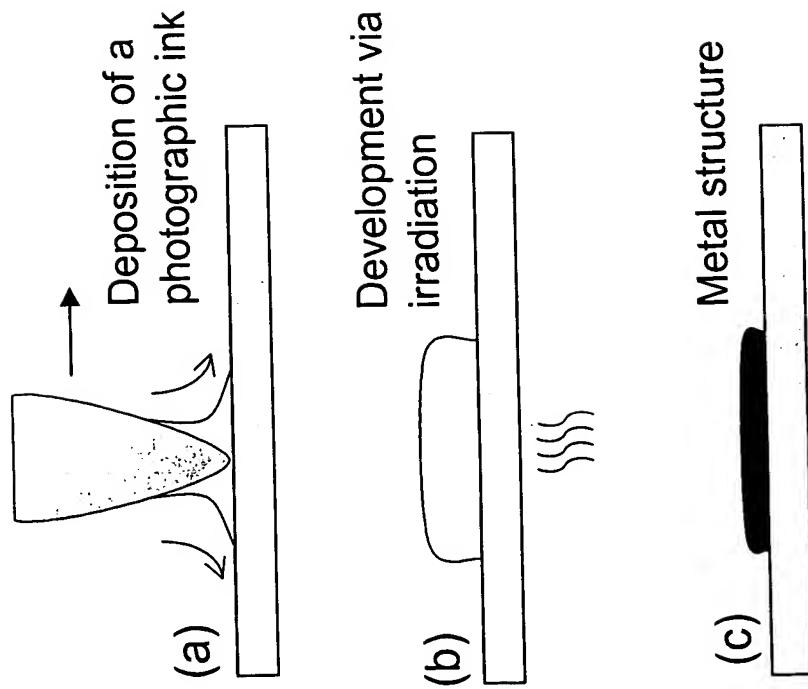
Figure 12



(d)

(e)

(f)



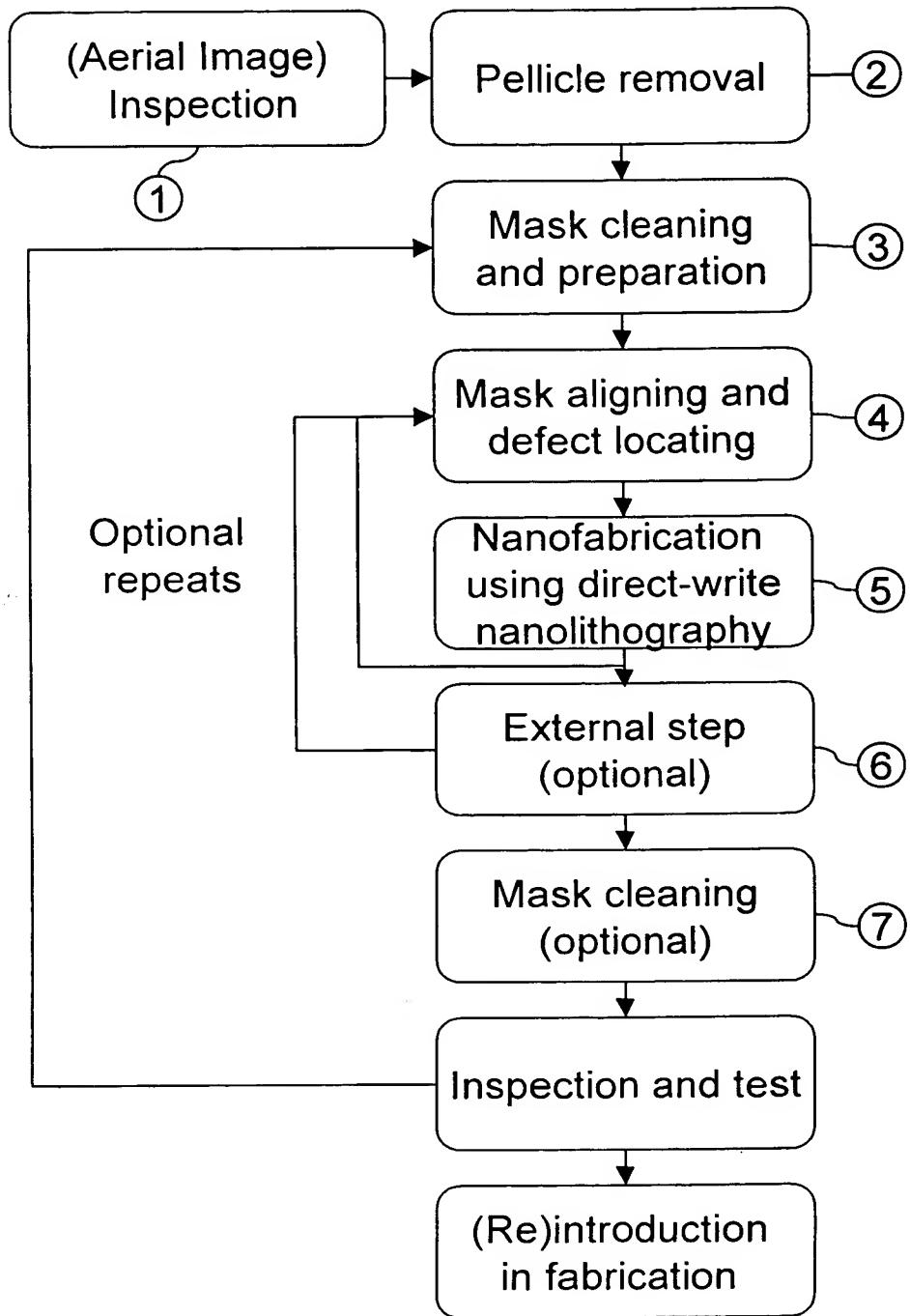


Figure 13

Figure 14A

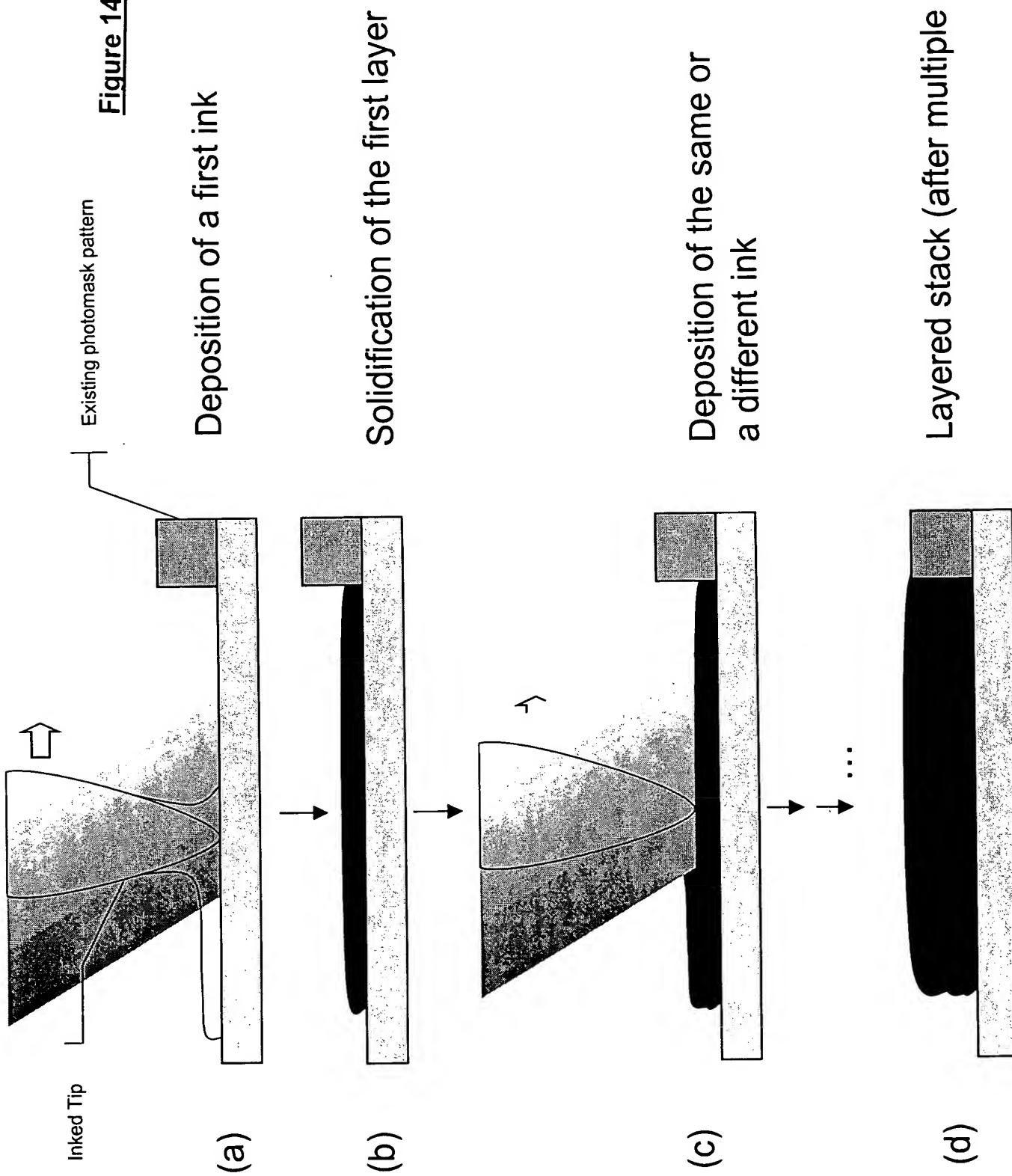


Figure 14B

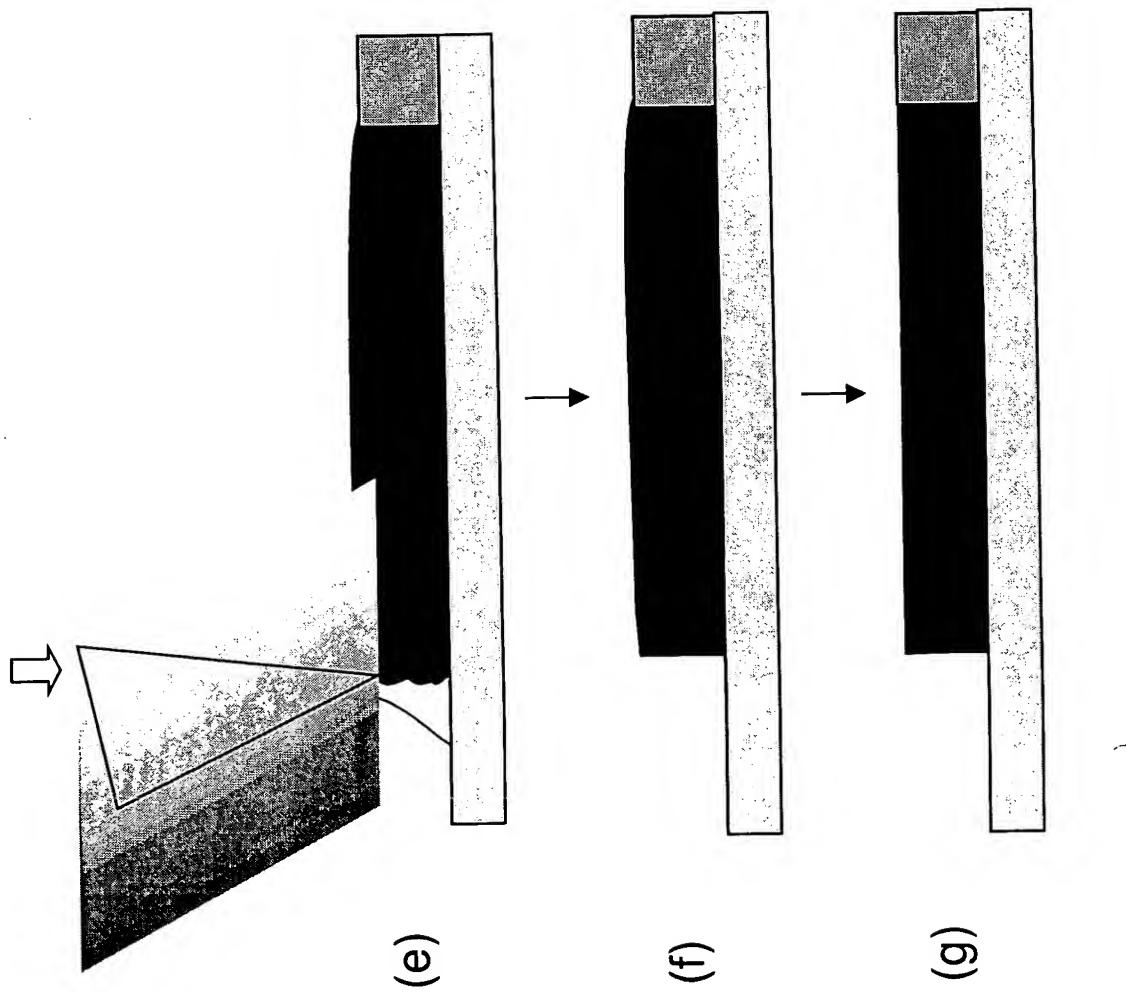
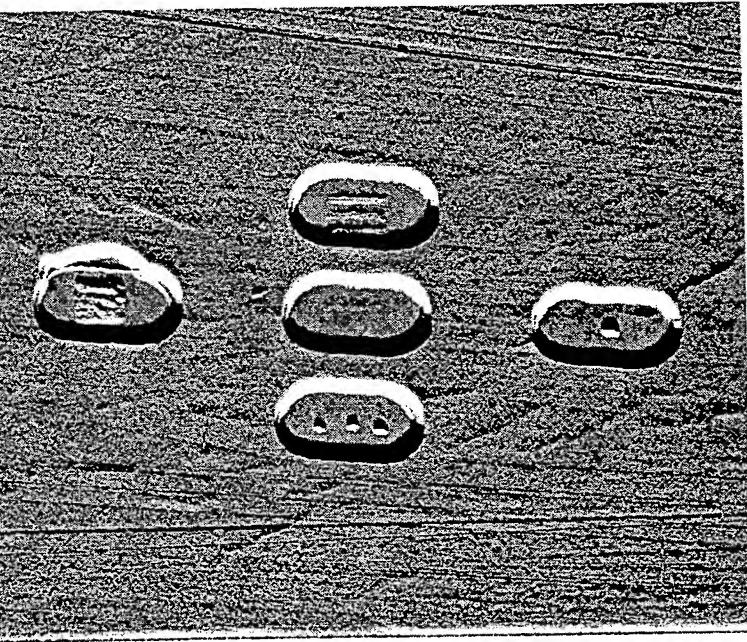


Figure 15

Zoomed Out View



Sol-Gel Structures in one of
the smallest features in Binary
Mask

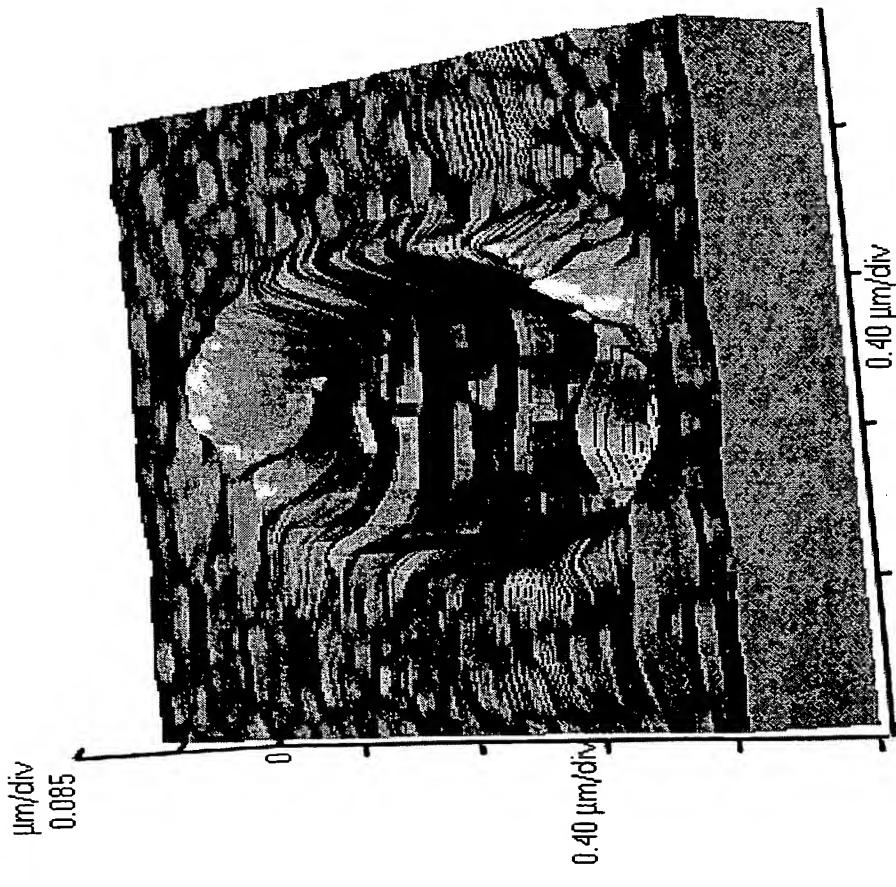
The features (5 holes) in the
mask are $1\mu\text{m} \times 2\mu\text{m}$.

Nano Structures were
successfully created in smaller
features too.

Figure 16

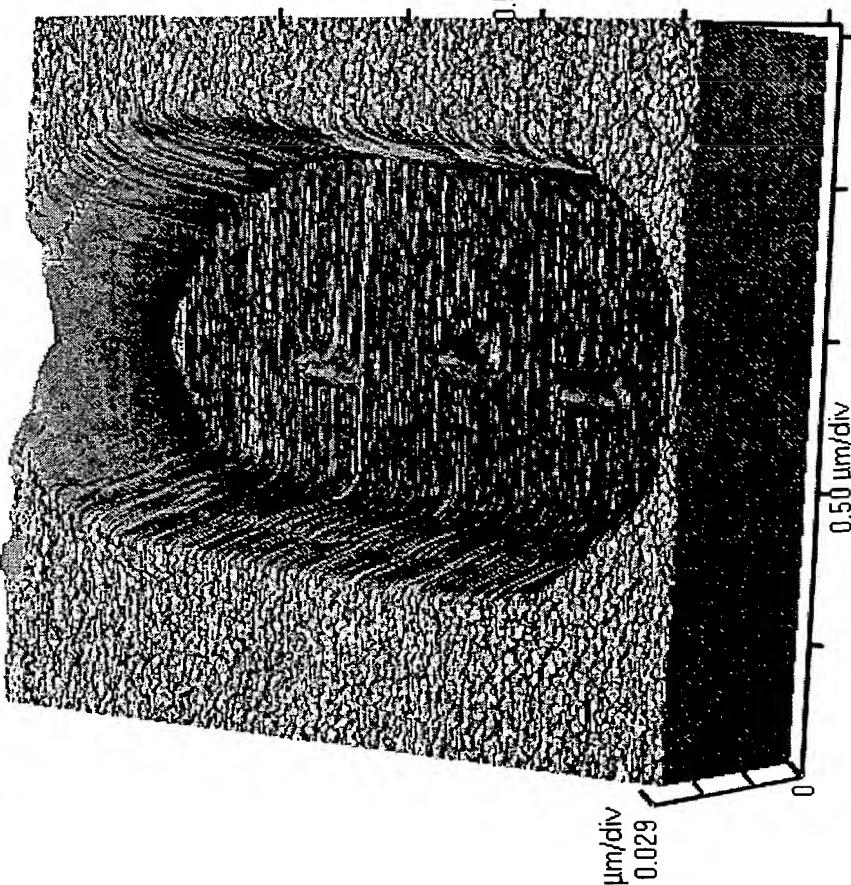
Target Hole

Shown was the target feature to
be used for deposition of Sol-
Gel structures
The dimensions of the hole are
Length 2 μ m
Width 1 μ m
Height 75 nm



Dots in the Features

Figure 17



Dots were created, demonstrating the control over height of the feature and the registration. The dimensions starting from top feature

- H 17 nm W 128 nm T 3 min
- H 17.5 nm W 150 nm T 3.5 min
- H 18.5 nm W 163 nm T 4 min

Figure 18

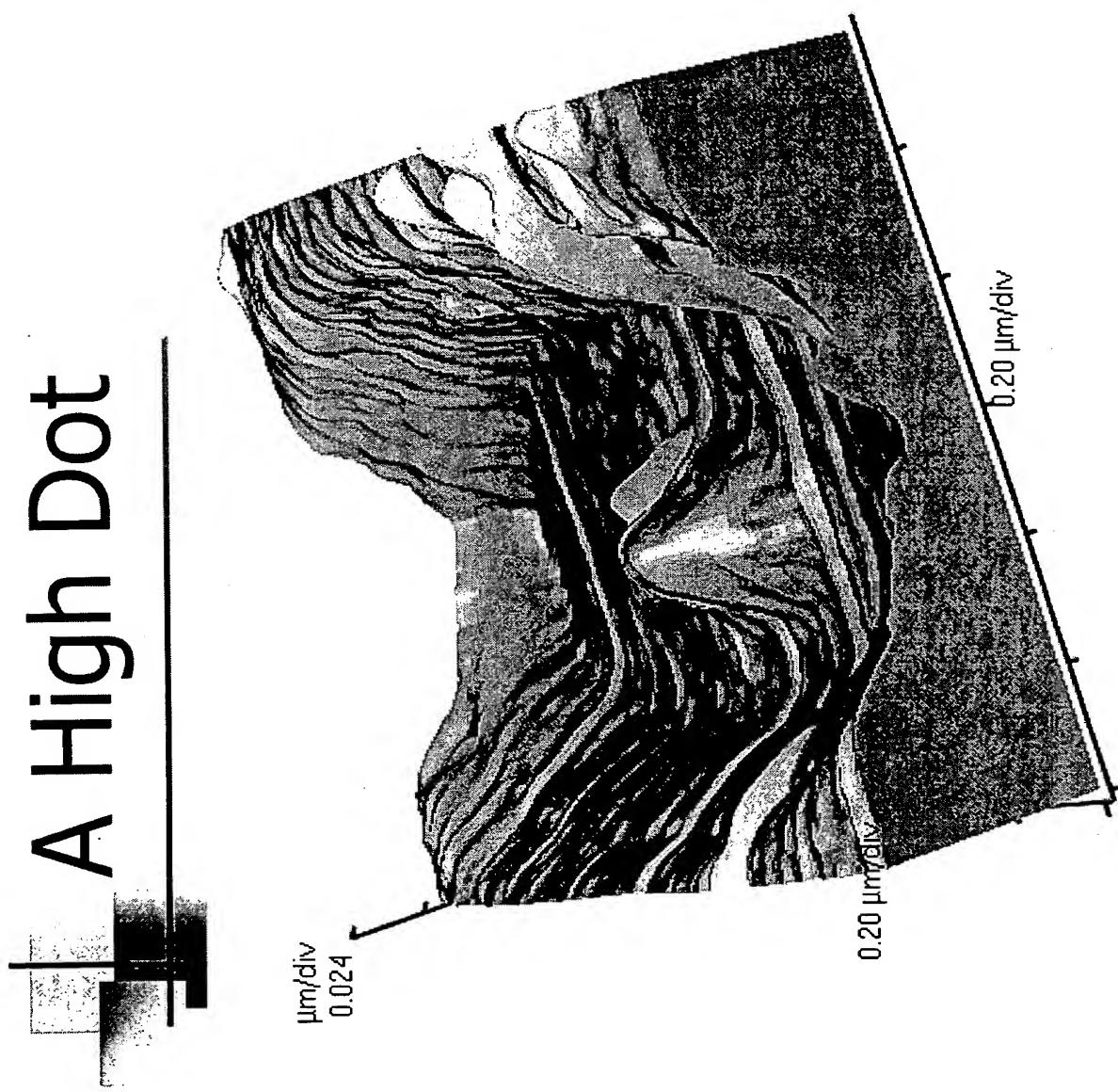
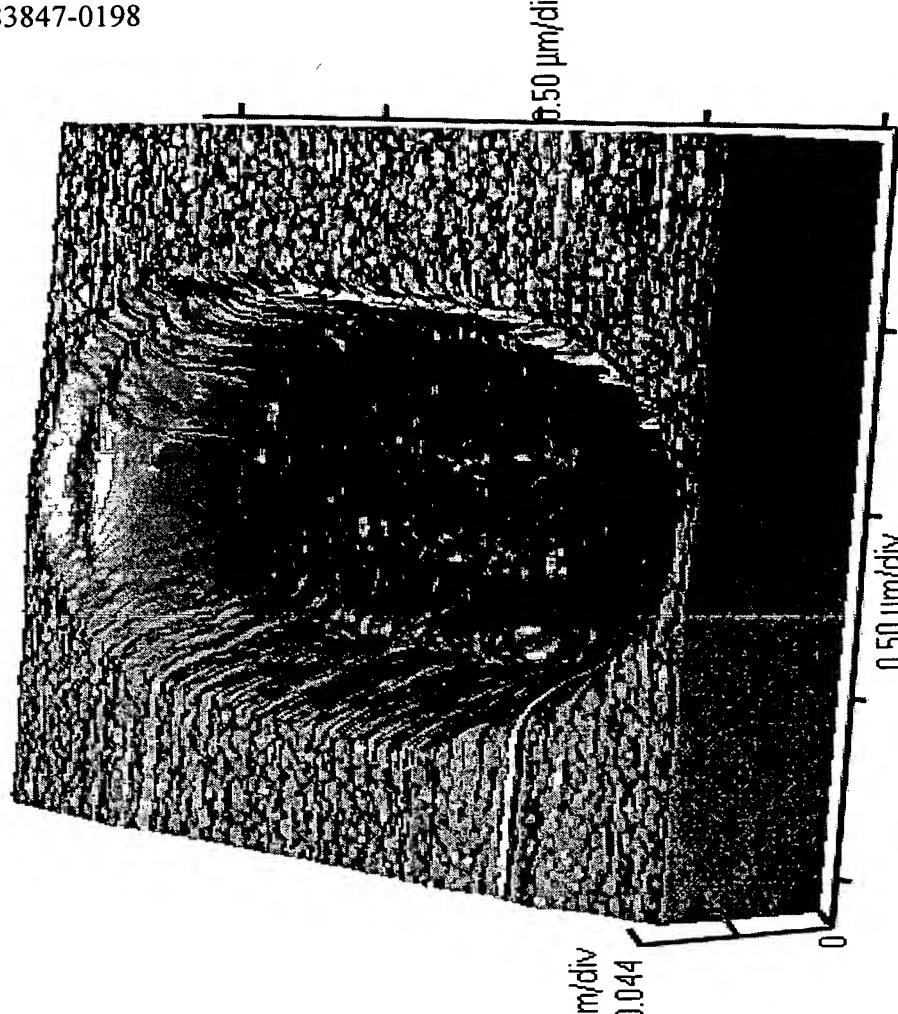


Figure 19

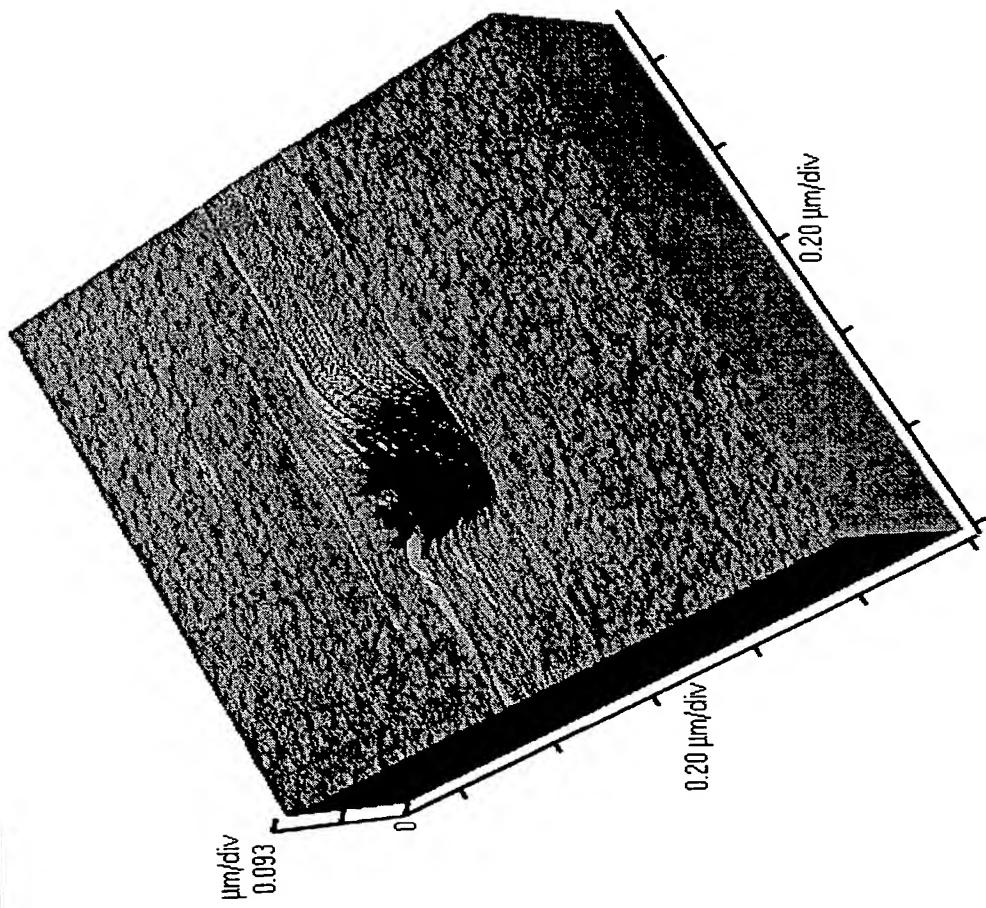
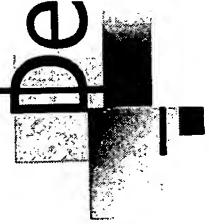
Lines in the Feature

These three lines were created, one exactly alongside the defect edge. The dimensions for the lines starting from left are:

- H 15 nm W 162 nm T 6 min
- H 10 nm W 150 nm T 5 min
- H 5 nm W 138 nm T 4 min



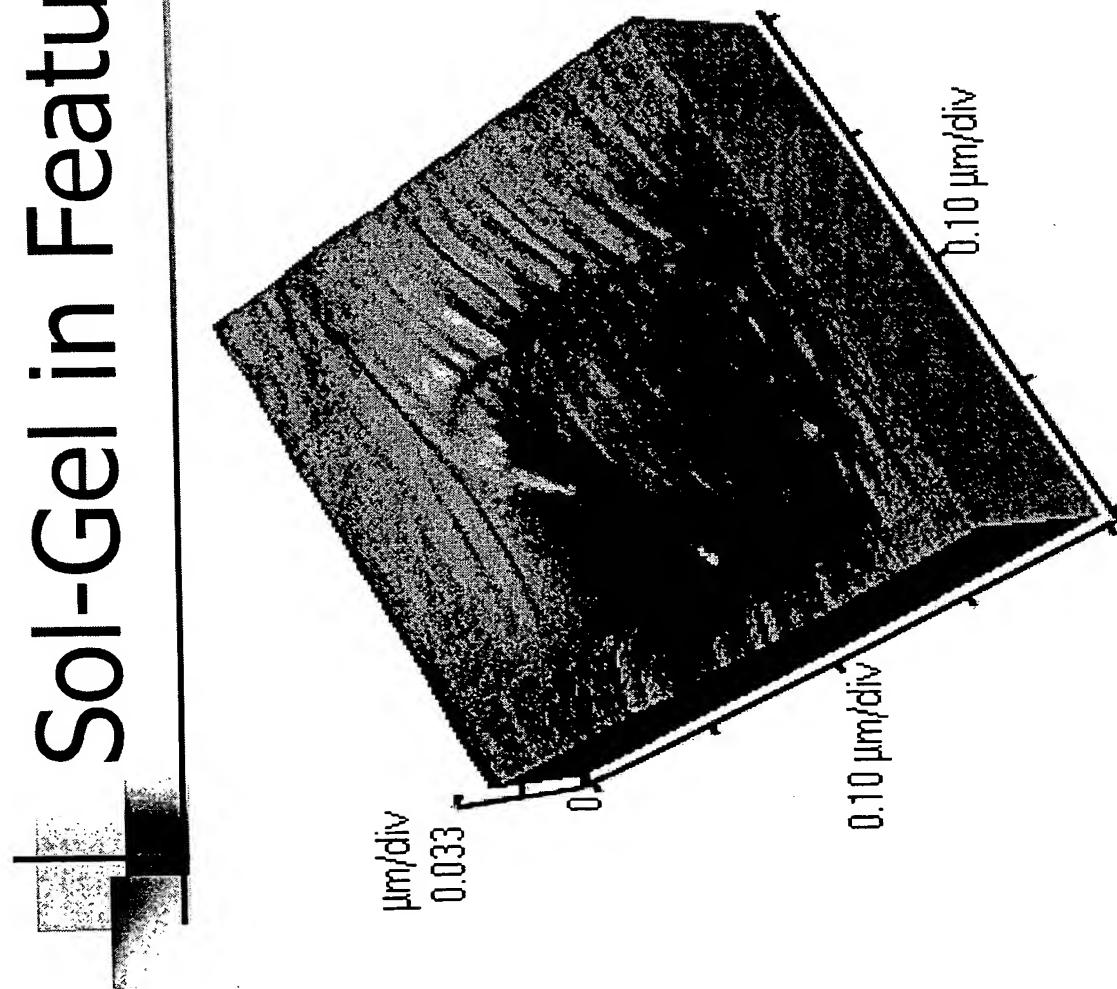
Target Hole on FIBics Structures for Deposition of Metal Salt and sol-gel



This hole is ~200 nm wide and 100 nm deep. This was the target hole for deposition of sol-gel structure and metal ink.

Figure 20

Sol-Gel in Features by FIBICS

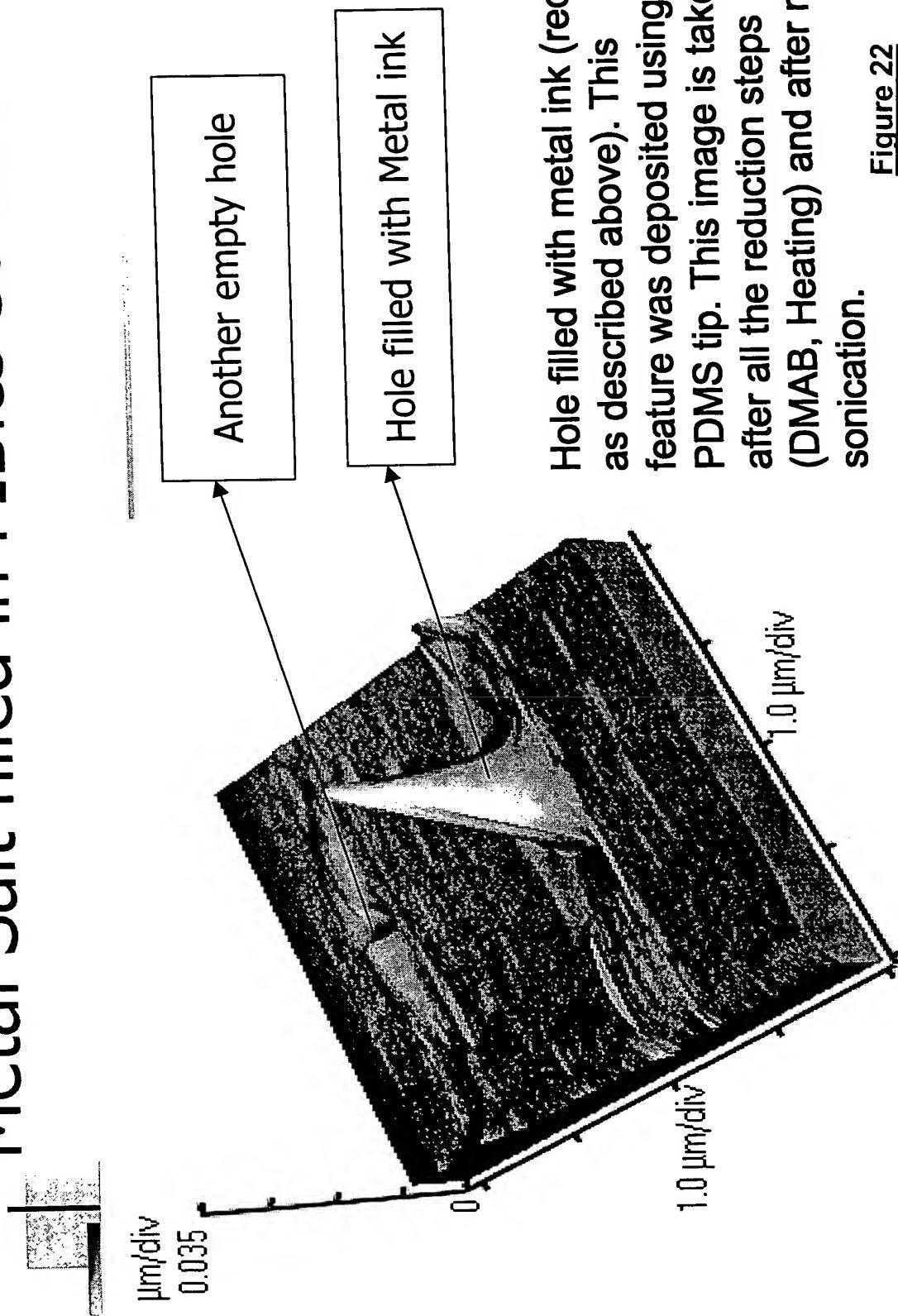


An attempt to fill up a hole in features made with FIB. The average height of the feature deposited is 46 nm. A SiN_3 tip was used in this experiment.

Sol-Gel composition same as mentioned before. Dwelling time was 14 min. The deposited structure were cured at 120° C for 6 min.

Figure 21

Metal Salt filled in FIBiCS Structures



Building up of Metal Structure by Layering

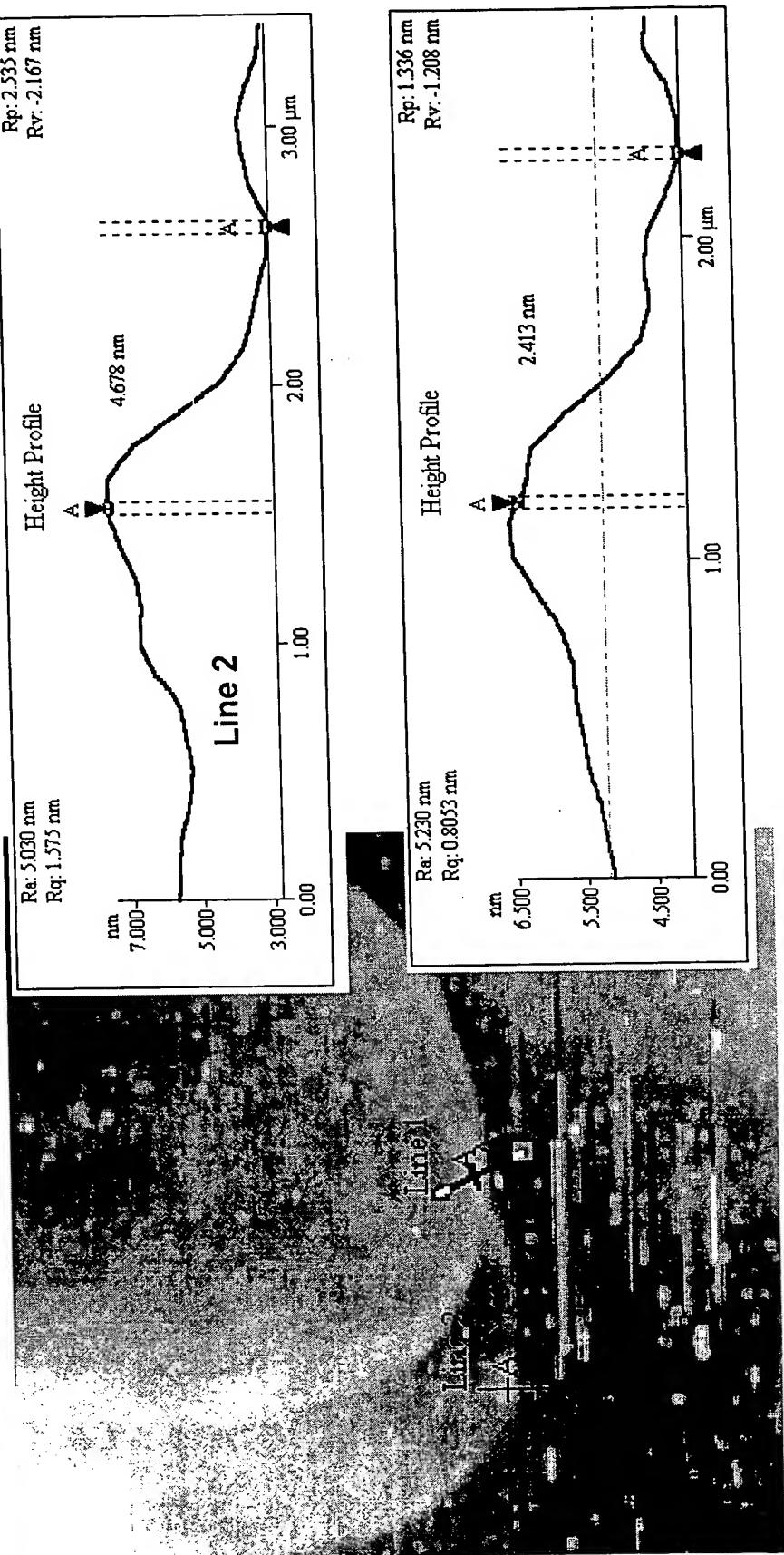
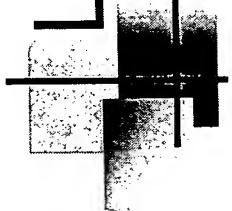


Figure 23

Schematic Representation: Fabrication of PDMS-Coated DPN Stamp Tip

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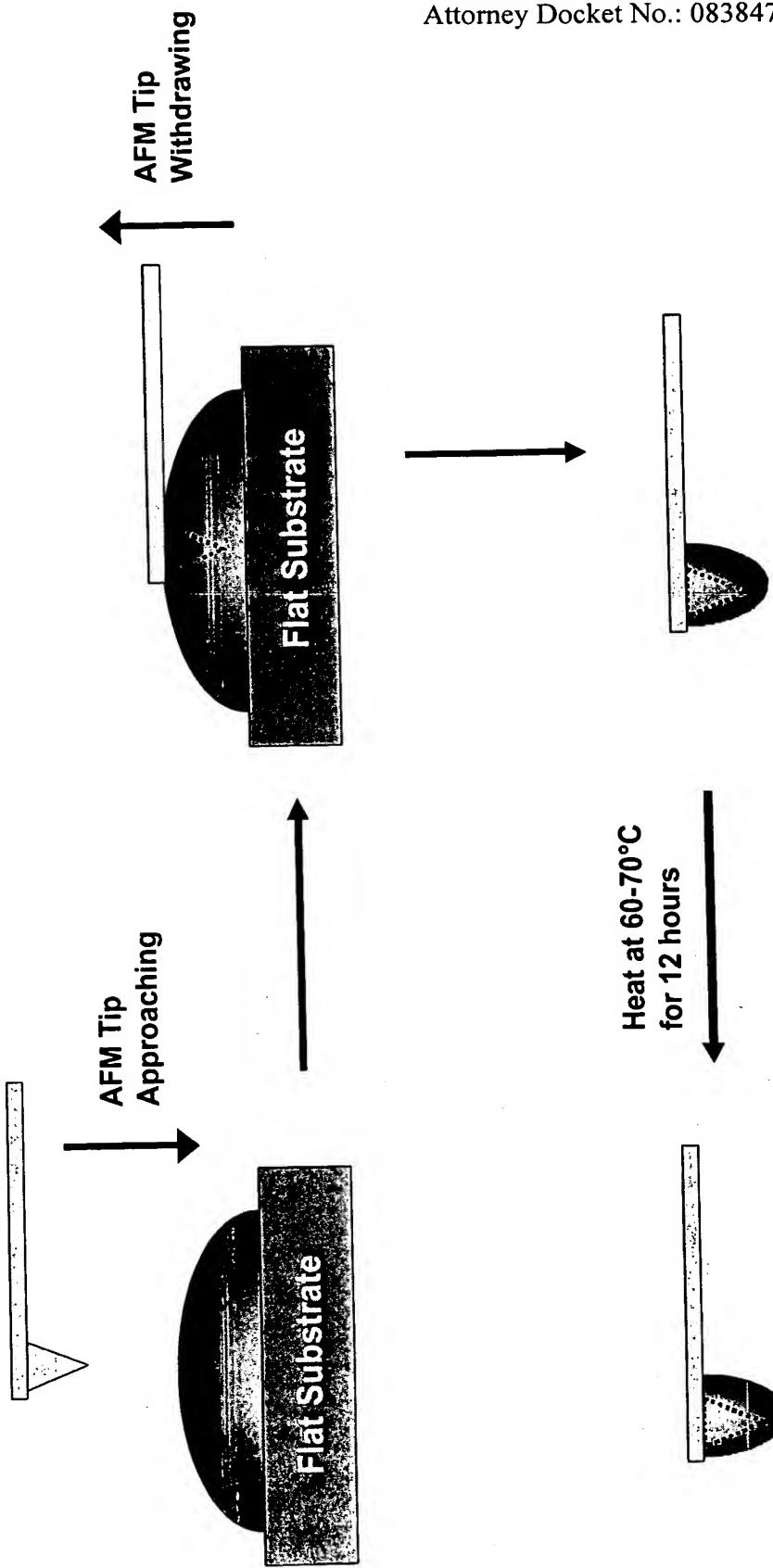


Figure 24

PDMS-coated DPN Stamp tip

Optical Microscopy Image of a PDMS- Coated DPN Stamp Tip

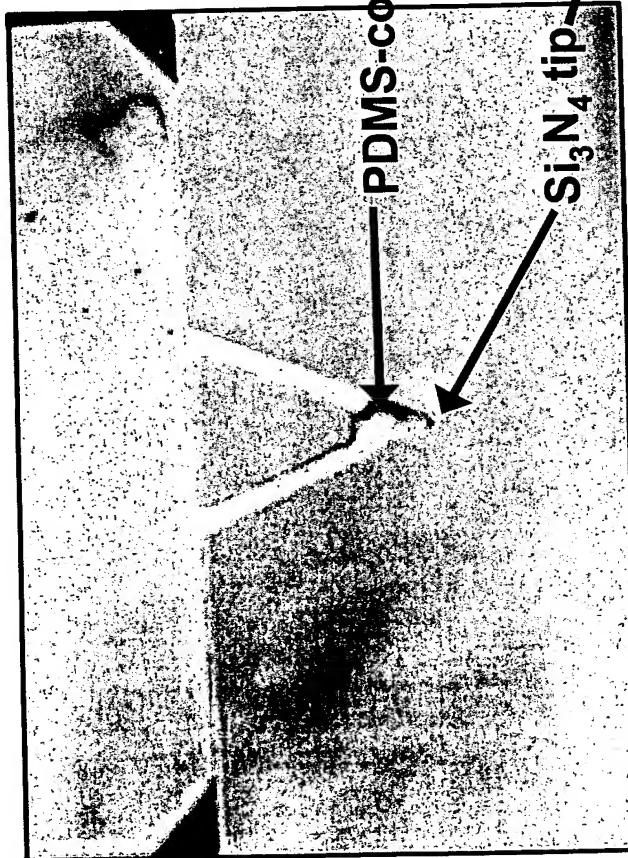
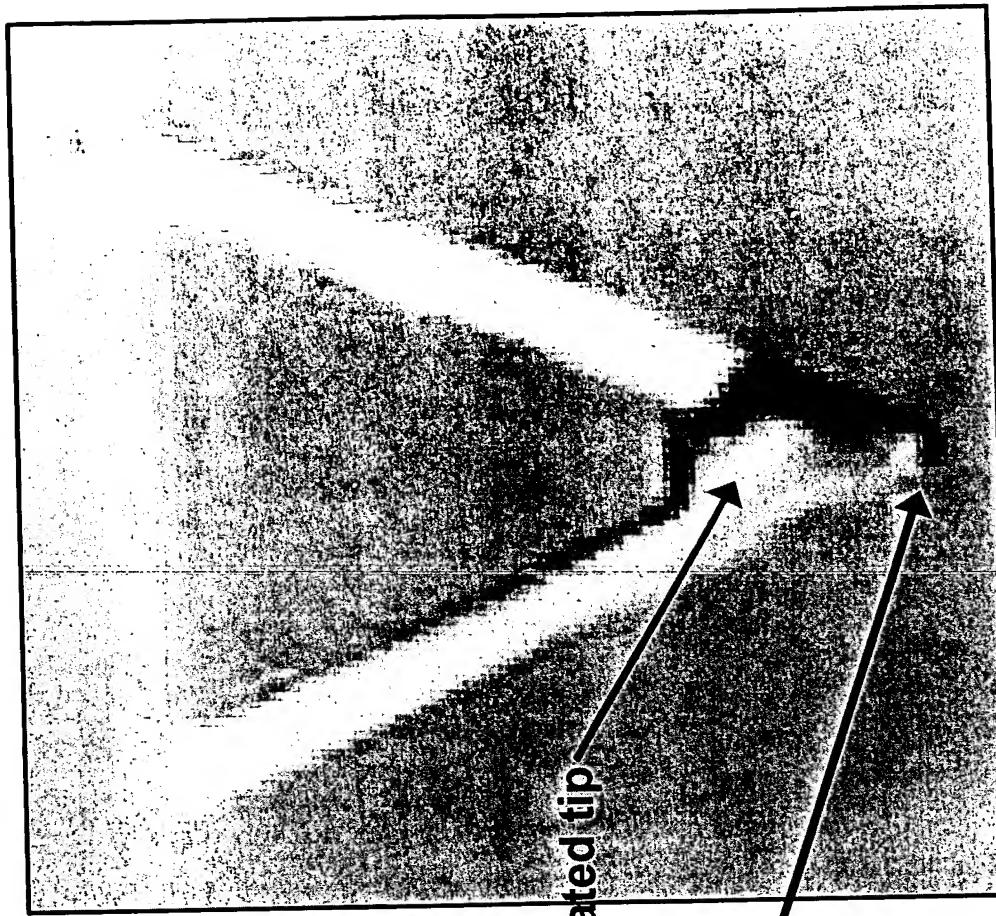


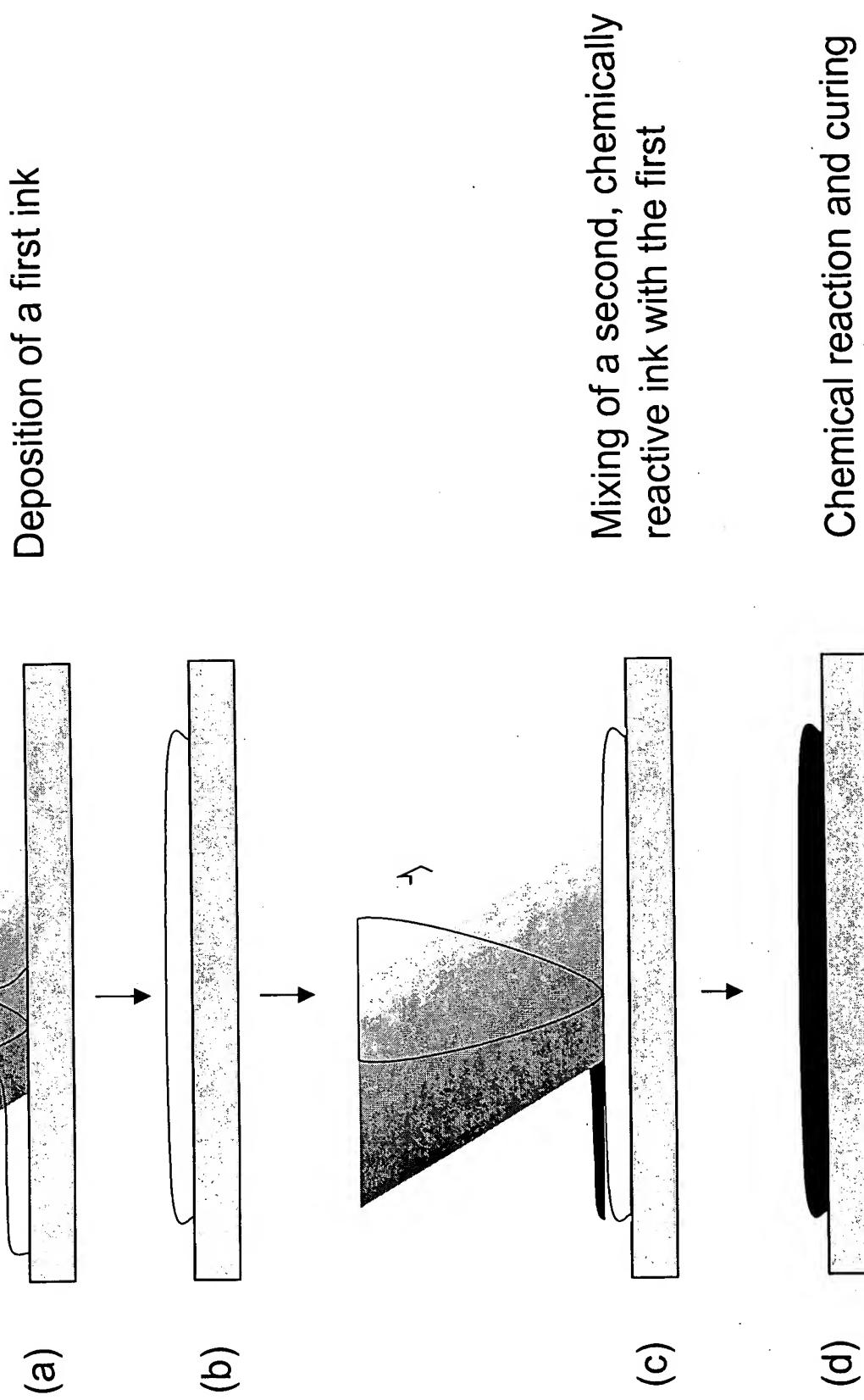
Figure 25

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Inventor(s): Percy Van Crocker et al.

Attorney Docket No.: 083847-0198

Figure 26



Deposition of a first ink

Local curing by irradiation
from a NSOM tip

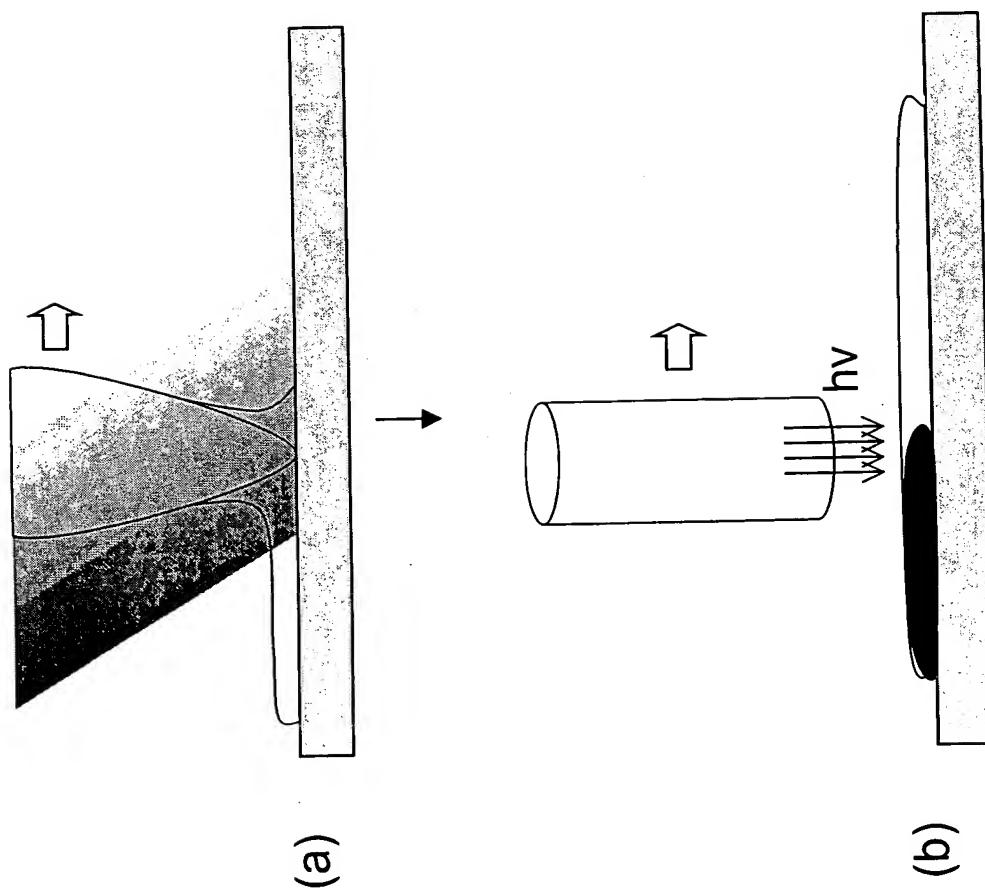


Figure 27